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Mesodictyopsis Khursevich, Iwashita, Kociolek and Fedenya

A New Genus of Diatoms in the Class Coscinodiscophyceae (Bacillariophyta) from Upper Miocene Sediments of Lake Baikal, Siberia

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A new freshwater genus *Mesodictyopsis*, studied with light (LM) and scanning electron microscopy (SEM), has been distinguished in the class Coscinodiscophyceae (Bacillariophyta) from Upper Miocene sediments of Lake Baikal. It is diagnosed by a combination of the following morphological features: a) location of the areola cribrum inside the loculus; b) arrangement of areolae on the valve face in uniseriate striae or in narrow or broad fascicles subdivided by hyaline strips or costae; c) various positions of rimoportula(e) on the valve surface; d) presence of marginal fultoportulae with three satellite pores; e) presence of valve face fultoportulae. Six new species are described. Another species, *Stephanodiscus dzhilindus* Khursevich, from the Dzhilinda basin of the Transbaikal area, appears to also share these same features. We propose to transfer this species to *Mesodictyopsis*. *Mesodictyopsis* is distinguished from its close ally, *Mesodictyon* Theriot and Bradbury, in the structure and placement of fultoportulae and position of rimoportula(e).

Key words: Bacillariophyta, Coscinodiscophyceae, diatoms, new genus, *Mesodictyopsis*, Late Miocene, Lake Baikal.

Lacustrine sediments of long continuous sections from Lake Baikal are important archives for studying the evolution of freshwater centric diatoms. Plio-Pleistocene diatom succession is well documented in the sedimentary record of Lake Baikal from BDP 96-1 and BDP 96-2 cores (Grachev et al. 1998; Khursevich et al. 1998, 2000, 2001a–c). The above-mentioned sections, as well as the new 600-m long drill core BDP-98, have recovered a continuous diatom record of the past 10 Ma (BDP-Members 2000) and show that the Pleistocene time interval is characterized by active speciation within the genus *Stephanodiscus* Ehrenberg. The Pliocene epoch is distinguished by the appearance, speciation and extinction of the genus *Stephanopsis* Khursevich & Fedenya. The Late Miocene differs by the appearance, speciation and extinction of a group of species whose

features do not allow placement into any previously described genus. The description of this new diatom genus, *Mesodictyopsis*, including six species from the Upper Miocene deposits of Lake Baikal, is given in the present report

Materials and Methods

The 600 m long borehole BDP-98 was drilled by the Russian company "Nedra Enterprise" during winter 1998 using the Baikal-2000 drilling complex placed on a barge. The drilling was performed on the Academician Ridge of Lake Baikal at 53°44′48″ N and 108°24′34″ E in water depth of 333 m. Continuous samples were collected to a depth of 600 m. Total core recovery was over 95%. Sediments consist of alternating biogenic diatomaceous ooze and terrigenous clay intervals. The age model for the BDP-98 section is based on the correlation of event/reversal boundaries with the reference polarity time scale (Cande and Kent 1995). Proceeding from paleomagnetic investigations and analysis of the Earth's orbital frequencies in the climatic record of the core, the sediments at a depth of 600 m have a preliminary date of 10.3 Ma (BDP-Members 2000). The Upper Miocene deposits occur in the BDP-98 core at the depth interval between approximately 600 and 221 m according to the preliminary age model for this core.

Permanent diatom slides were prepared with identical volumes of material according to the method described in Grachev *et al.* (1997). Diatoms were enumerated along vertical and horizontal transects of permanent slides in 50 or 200 fields of view depending upon diatom concentration. The distributions of total diatoms, as well as of dominant individual planktonic diatom genera including *Mesodictyopsis*, were quantitatively determined for the interval of core depth between 600 and 221 m. Elsewhere, ranked abundances (mln valves per gram of dry sediments) were used. Specimens were examined using oil immersion light microscopy (Ergaval brightfield, NA=1.25 in IGS, Belarus; DMRB with DIC optics, NA=1.4 in CAS) and scanning electron microscopy (JEOL JSM-35C in IGS, Belarus and JEOL JSM-6330F in IGPS, Sendai, Japan). To describe the new fossil diatom species, the terminology recommended by Ross et al. (1979) was used. The structural elements on the valve were measured using the procedure of Anonymous (1975) on not less than 30 complete diatom valves of each new taxon.

Results

Genus *Mesodictyopsis* Khursevich, Iwashita, Kociolek, and Fedenya, gen. nov.

Description: Frustules low-cylindrical with few intercalary bands. Valves circular, 3.0–91.5 μm in diameter, more or less flat; occasionally the central area is markedly concave or convex. Areolae loculate, having a cribrum on the inside of each loculus and a foramen on both the internal and external valve surfaces. Areolae arranged in radial rows of unequal length or in narrow or broad fascicles divided by hyaline strips or costae. Mantle not separated from the valve face by a sharp angle, but curved outwards; 1–5 μm in wide, with areolae closer and smaller than those on the valve face; the outermost row of areolae larger. On the valve surface one rimoportula, occupying various positions (at the center, near the center, in the submarginal zone of the valve face, on the valve face/mantle junction or on the mantle) or several rimoportulae (up to 7) forming a ring on the boundary between the valve face and mantle. Internal opening of the rimoportulae is a slightly raised slit; external opening is a pore or small tube. Fultoportulae on the valve face with three, rarely two or four, satellite pores internally, represented by small external apertures. Marginal fultoportulae with three satellite pores on the internal valve surface, appearing as small openings or tubes at the base of hyaline strips externally. A ring of spines is almost always present at the valve face/mantle junction.

Type species.— *Mesodictyopsis academicus* Khursevich, Iwashita, Kociolek, and Fedenya, sp. nov.

Type locality.— The underwater Academician Ridge of Lake Baikal, Russia, borehole BDP-98 (53°44′48″N; 108°24′34″E). Abundant in the Upper Miocene deposits.

Comments.— The new genus differs from *Mesodictyon* Theriot and Bradbury (Theriot and Bradbury 1987) in several aspects. The medial velum of *Mesodictyopsis* (a clean siliceous plate within loculate areola) is of a type different from that seen in *Mesodictyon* (a distinct medial cribrum in areola in Mesodictyon). In *Mesodictyopsis*. the position of rimoportulae is highly variable, while in *Mesodictyon* the rimoportula is always found on the valve mantle, behind the marginal fultoportula internally. *Mesodictyon* is known to have occurred from 12–11 Ma to 7 Ma in the western USA, Peru, France, Bulgaria, Belarus, and in Lake Baikal (*Mesodictyon nativus* has the age range ca. up to 6.5 Ma). *Mesodictyopsis* is endemic to Lake Baikal region with the age range from ca.7–5.1 Ma (the end of Late Miocene-earliest Pliocene). In Lake Baikal there is a long, continuous sedimentary record where there are several endemic freshwater centric diatom genera (*Concentrodiscus*, *Stephanopsis*) which replace each other from bottom to top and have some common inherited morphological features (such as the various inconstant position of rimoportula on the valve surface including some taxa with the location of rimoportulae in or near the center of the valve). This situation is wanting in *Mesodictyon* species. Lake Baikal has very high levels of endemism, not only of species, but also genera (among many organisms including diatoms). The extinct endemic genera *Mesodictyopsis* and *Stephanopsis*, for example, have marginal fultoportulae with three satellite pores and the valve face fultoportulae with three satellite pores. We know many closely related centric genera with external cribra (*Actinocyclus*, *Cestodiscus*, *Cosmiodiscus* and others), many genera with internal cribra (*Thalassiosira*, *Concentrodiscus*, *Stephanodiscus* and others), and now we recognize several genera with a medial velum.

We have recognized six new species in this genus; these are described below.

***Mesodictyopsis academicus* Khursevich, Iwashita, Kociolek, and Fedenya, sp. nov.**
(Plate 1, Figs 1–3, 6; Plate 2, Figs 1–6. Plate 1, figure 1 is of the holotype.)

Description.— Valves circular, 9.5–50.0 μm in diameter. Areolae 10–25 in 10 μm along the valve radius, arranged in radial, uniseriate striae or extending from the center and becoming bi- or triseriate fascicles in the submarginal zone of the valve face. Hyaline strips or costae divide uniseriate striae or fascicles from each other and continue from the valve face to the mantle, (6)8–16 in 10 μm. A single rimoportula, usually positioned in the valve center or near the center. Valve face fultoportulae, 2–14, each with three satellite pores, situated within the central area in radial areolar rows replacing 1–4 areolae per row. Valve mantle (up to 2 μm in height) with 2-5 small areolae in a vertical row, with 36–40 rows of areolae in 10 μm. Marginal fultoportulae with three satellite pores, (6)8-16 in 10 μm, located at the base of each hyaline strip, rarely every second or third one. A ring of irregularly located spines may be present at the valve face/mantle junction.

Holotype.— Slide No. 3495a, BDP-98, core 198-1 (18 cm), deposited at the Institute of Geological Sciences, National Academy of Sciences of Belarus, Minsk, Belarus.

Isotype.— Slide No. 3495b, BDP-98, core 198-1 (18 cm), deposited at the Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences, Irkutsk, Russia.

Type material.— Housed in the G. K Khursevich Collection at the Institute of Geological Sciences, National Academy of Sciences of Belarus, Minsk, Belarus; Baikal Drilling Project Collection, Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences, Irkutsk, Russia, and in Diatom Collection, California Academy of Sciences, San Francisco, USA.

TYPE LOCALITY.— The underwater Academician Ridge of Lake Baikal, Russia, borehole BDP-98, depth 334-461 m from sediment surface.

***Mesodictyopsis medius* Khursevich and Iwashita, sp. nov.**
(Plate 1, Fig. 11; Plate 3, Figs. 1–6. Plate 1, Fig. 11 is of the holotype.)

DESCRIPTION.— Valves circular, more or less flat, 11.0–24.5 µm in diameter. Areolae 14–16(20) in 10 µm along the valve radius, arranged in radial rows of unequal length separated by hyaline strips, 14–18 in 10 µm. A single rimoportula situated in the valve center and surrounded by a hyaline ring. Valve face fultoportulae (from 3 to 9), each with three satellite pores, form an irregular ring at a distance of ⅓–½ from the valve center. Valve mantle (1–2 µm in height) has 2–4 small areolae in a vertical row (35–40 areolar rows in 10 µm near the edge of mantle) and a marginal ring of fultoportulae with three satellite pores, 8–12(14) in 10 µm, located at the base of each or every second or third hyaline strip. Spines may be present at the valve face/mantle junction.

HOLOTYPE.— Slide No. 108616, BDP-98, core 231-1 (91 cm) deposited at the Institute of Geology and Paleontology, Graduate School of Science, Tohoku University, Sendai, Japan.

TYPE MATERIAL.— Housed in the IGPS Collection at the Institute of Geology and Paleontology, Graduate School of Science, Tohoku University, Sendai, Japan; Baikal Drilling Project Collection, Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences, Irkutsk, Russia.

TYPE LOCALITY.— The underwater Academician Ridge of Lake Baikal, Russia, the borehole BDP-98, depth 403-424 m from sediment surface.

COMMENTS.— This species differs from *Mesodictyopsis academicus* by the presence of non-fasciculated striae of areolae only and valve face fultoportulae forming an irregular ring in the middle of the valve radius.

***Mesodictyopsis peculiaris* Khursevich, Kociolek, and Fedenya, sp. nov.**
(Plate 1, Fig. 13; Plate 4, Figs. 1–2. Plate 1, Fig. 13 is of the holotype.)

DESCRIPTION.— Valves circular, flat or slightly convex, 3.0–9.5 µm in diameter. Areolae, up to 20 in 10 µm along the radius, located in single radial rows divided by hyaline strips, 15–20 in 10 µm. Not all rows of areolae reach the valve center; hence the center not densely structured. One fultoportula with two satellite pores occurs near the valve center. A single rimoportula occurs in the submarginal zone of the valve face, between two closely located marginal fultoportulae. 4–6 fultoportulae with three satellite pores on the mantle; among which two are placed close to one another, the rest widely spaced. Valve mantle shallow (up to 1 µm high), consisting of 1–2 small areolae in a vertical row. Spines positioned at every hyaline strip at the valve face/mantle junction; often broken.

HOLOTYPE.— Slide No. 3495a, BDP-98, core 198-1 (18 cm), deposited at the Institute of Geological Sciences, National Academy of Sciences of Belarus, Minsk, Belarus.

ISOTYPE.— Slide No. 3495b, BDP-98, core 198-1 (18 cm), deposited at the Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences, Irkutsk, Russia.

TYPE MATERIAL.— Housed in the G.K. Khursevich Collection at the Institute of Geological Sciences, National Academy of Sciences of Belarus, Minsk, Belarus; Baikal Drilling Project Collection, Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences, Irkutsk, Russia, and in Diatom Collection, California Academy of Sciences, San Francisco, USA.

TYPE LOCALITY.— The underwater Academician Ridge of Lake Baikal, Russia, borehole BDP-98, depth 328–377 m from sediment surface.

Comments: This species differs from *Mesodictyopsis medius* by the smaller size of valves, as well as the specific location of a single rimoportula and marginal fultoportulae on the valve surface.

***Mesodictyopsis singularis* Khursevich, Iwashita, and Fedenya, sp. nov.**
(Plate 1, Figs. 7, 10, 14–15; Plate 4, Figs. 3–5. Plate 1, Fig. 7 is of the holotype.)

Description.— Valves circular, more or less flat, 4.0–17.2 µm in diameter. Areolae 12–16 (20) in 10 µm along the radius, grouped in uniseriate radial striae of unequal length, separated by hyaline strips, 14–18 in 10 µm. One–several fultoportulae, each with three satellite pores, found near the valve center. A single rimoportula occurs just inside the ring of marginal fultoportulae. Marginal fultoportulae with three satellite pores, (6)8–10 in 10 µm, located at the base of each or every second, rarely every third hyaline strip on the mantle. Valve mantle (up to 1 µm high) perforated by 1–3 small areolae in a vertical row (up to 40 rows of areolae in 10 µm). Small pointed spines usually present at every hyaline strip on the boundary between the valve face and mantle.

Holotype.— Slide No. 3040a, BDP-98, core 174-1 (68 cm), deposited at the Institute of Geological Sciences, National Academy of Sciences of Belarus, Minsk, Belarus.

Isotype.— Slide No. 3040b, BDP-98, core 174-1 (68 cm), deposited at the Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences, Irkutsk, Russia.

Type material.— Housed in the G.K. Khursevich Collection at the Institute of Geological Sciences, National Academy of Sciences of Belarus, Minsk, Belarus, and Baikal Drilling Project Collection, Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences, Irkutsk, Russia.

Type locality.— The underwater Academician Ridge of Lake Baikal, Russia, borehole BDP-98, depth 304-452 m from sediment surface.

Comments.— This species differs from *Mesodictyopsis peculiaris* by the more dense placement of marginal fultoportulae.

***Mesodictyopsis baicalensis* Khursevich, Iwashita, Kociolek, and Fedenya, sp. nov.**
(Plate 1, Figs. 4–5, 8, 17–18; Plate 5, Figs. 1–6, Plate 6, Figs 1–6. Plate 1, Fig. 5 is of the holotype.)

Description.— Valves circular, with markedly concave or convex central area, 15.5-91.0 µm in diameter. Areolae, 11–18(20) in 10 µm along the valve radius, arranged in radial uniseriate uneven striae within the central area becoming bi- multiseriate fascicles (up to 5 areolar rows) in the submarginal zone of the valve face. Fascicles of areolae divided by hyaline strips or costae, 5-7 in 10 µm, continuing from the valve face to the mantle. 1 to 7 valve face fultoportulae, each with three satellite pores (rarely one fultoportula may have four satellite pores), occur in the valve center or near the center replacing 1–4 areolae per row. Rimoportulae (1–7) located in the upper part of the valve mantle a little below the spine insertion; appear as short tubes, externally, and slightly raised slit oriented variously, internally. Rimoportulae may be positioned both on hyaline strips and in radial areolar rows. Valve mantle (up to 5 µm high) with 2–8 small areolae in a vertical row (30-40 rows of areolae in 10 µm) and a ring of marginal fultoportulae located at the base of each or every second, rarely every third, hyaline strip. Marginal fultoportulae having three satellite pores internally and small tubes externally. Conic spines are spaced irregularly at the valve face/mantle junction.

Holotype.— Slide No. 2810a, BDP-98, core 150-1 (18 cm), deposited at the Institute of Geological Sciences, National Academy of Sciences of Belarus, Minsk, Belarus.

Isotype.— Slide No. 2810b, Bdp-98, core 150-1 (18 cm), deposited at the Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences, Irkutsk, Russia.

Type material.— Housed in the G.K. Khursevich Collection at the Institute of Geological Sciences, National Academy of Sciences of Belarus, Minsk, Belarus; Baikal Drilling Project Collection, Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences, Irkutsk, Russia, and in Diatom Collection, California Academy of Sciences, San Francisco, USA.

Type locality.— The underwater Academician Ridge of Lake Baikal, Russia, borehole BDP-98, depth 259-302 m from sediment surface.

Comments.— This species differs from *Mesodictyopsis singularis* mainly by the larger size of valves, as well as by the presence of distinct areolar fascicles towards the margin of the valve face.

***Mesodictyopsis similis* Khursevich and Fedenya, sp. nov.**

(Plate 1, Figs. 9, 16; Plate 4, Figs. 6–7. Plate 1, Fig. 16 is of the holotype.)

Description.— Valves circular, flat or slightly convex, 3.5–10.0 μm in diameter. Areolae, 15–20 in 10 μm along the radius, arranged in short radial uniseriate striae extending from ⅓ to about ½ of the radius from the valve margin to the center. Hyaline strips separating uniseriate striae from each other 15–20 in 10 μm. Central area hyaline except the presence of a single valve face fultoportula with two satellite pores. One rimoportula occurs at the same level with marginal fultoportulae having three satellite pores. Valve mantle shallow (up to 1 μm high) with one areolae placed in a vertical row. Spine occurrence and placement difficult to determine, usually broken.

Holotype.— Slide No. 2525a, BDP-98, core 142-1 (94 cm), deposited at the Institute of Geological Sciences, National Academy of Sciences of Belarus, Minsk, Belarus.

Isotype.— Slide No. 2525b, BDP-98, core 142-1 (94 cm), deposited at the Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences, Irkutsk, Russia.

Type material.— Housed in the G.K. Khursevich Collection at the Institute of Geological Sciences, National Academy of Sciences of Belarus, Minsk, Belarus, and Baikal Drilling Project Collection, Institute of Geochemistry, Siberian Branch of Russian Academy of Sciences, Irkutsk, Russia.

Type locality.— The underwater Academician Ridge of Lake Baikal, Russia, borehole BDP-98, depth 254–304 m from sediment surface.

Comments.— This species differs from *Mesodictyopsis peculiaris* and *M. singularis* by the different location of a single rimoportula on the valve surface.

Discussion

There are now two freshwater genera (*Mesodictyon* and *Mesodictyopsis*) of the family *Stephanodiscaceae* Makarova which have the medial cribrum within the loculate areolae. This feature is the main diagnostic character of these genera. *Mesodictyon* has no valve face fultoportulae and possesses marginal fultoportulae with two satellite pores, while *Mesodictyopsis* has not only marginal fultoportulae with three satellite pores, but also valve face fultoportulae. In addition, the rimoportula(e) is typically on the mantle outside of the ring of marginal fultoportulae in *Mesodictyon* (Theriot 1990). As far as the species of *Mesodictyopsis* are concerned, they can be separated into three morphological groups with respect to the rimoportula(e) position on the valve surface.

One morphological group of *Mesodictyopsis* is composed of species characterizing by the location of a single rimoportula at the valve face/mantle junction or in the submarginal zone of the

valve face (*M. singularis, M. peculiaris*). The second group is based on the placement of a single rimoportula in the valve center or near the center (*M. academicus, M. medius*). Finally, the third morphological group is distinguished by the position of rimoportula(e) on the valve mantle (*M. baicalensis, M. similis*).

In general, species of *Mesodictyopsis* were found in the sediments of BDP-98 section in the interval of depth 461–254 m. According to the preliminary age model for the BDP-98 drill core (BDP-Members 2000), the appearance, development and extinction of *Mesodictyopsis* in the ancient basin proceeded during the Late Miocene period from ~ 8.5 to 6.0 Ma.

In our opinion, the species *Stephanodiscus dzhilindus* Khursevich, which occurs in the Miocene deposits within the Dzhilinda depression of the Transbaikal area (Khursevich 1994) should also be transferred to the genus *Mesodictyopsis*. Although cribra were not observed in specimens of *Stephanodiscus dzhilindus*, presence of funnel-like areolae, marginal fultoportulae with three satellite pores and a single valve face fultoportula suggest that *Mesodictyopsis* is its best generic placement. Hence, the new combination is proposed:

***Mesodictyopsis dzhilindus* (Khursevich) Khursevich.**

Basionym.— *Stephanodiscus dzilindus* Khursevich (Khursevich 1994: Morphology and taxonomy of some centric diatom species from the Miocene sediments of the Dzhilinda and Tunkin hollows. Pages 271–272 and fig. 3 *in* J.P. Kociolek, ed., *Proceedings of the 11th International Diatom Symposium, San Francisco*. Memoirs of the California Academy of Sciences no. 17).

The extinct genus *Mesodictyopsis* is characteristic both of the Upper Miocene sediments from Lake Baikal and the Transbaikal area.

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Plate 1

Light Microscopy

Species of *Mesodictyopsis* from the Upper Miocene sediments of BDP-98 drill core. Scale bar in fig. 1 =10 μm for all figures.

1–3, 6. *Mesodictyopsis academicus*. Fig. 1. Holotype specimen, BDP-98 core, 198-1, 18 cm.

4–5, 8, 17–18. *Mesodictyopsis baicalensis*. Fig. 5. Holotype specimen, BDP-98 core, 150-1, 18 cm.

7, 10, 14–15. *Mesodictyopsis singularis*. Fig. 7. Holotype specimen, BDP-98 core, 174-1, 68 cm.

9, 16. *Mesodictyopsis similis*. Fig. 16. Holotype specimen, BDP-98 core, 142-1, 94 cm.

11–12. *Mesodictyopsis medius*. Fig. 11. Holotype specimen, BDP-98 core, 231-1, 91 cm.

13. *Mesodictyopsis peculiaris* Holotype specimen, BDP-98 core, 198-1, 18 cm.

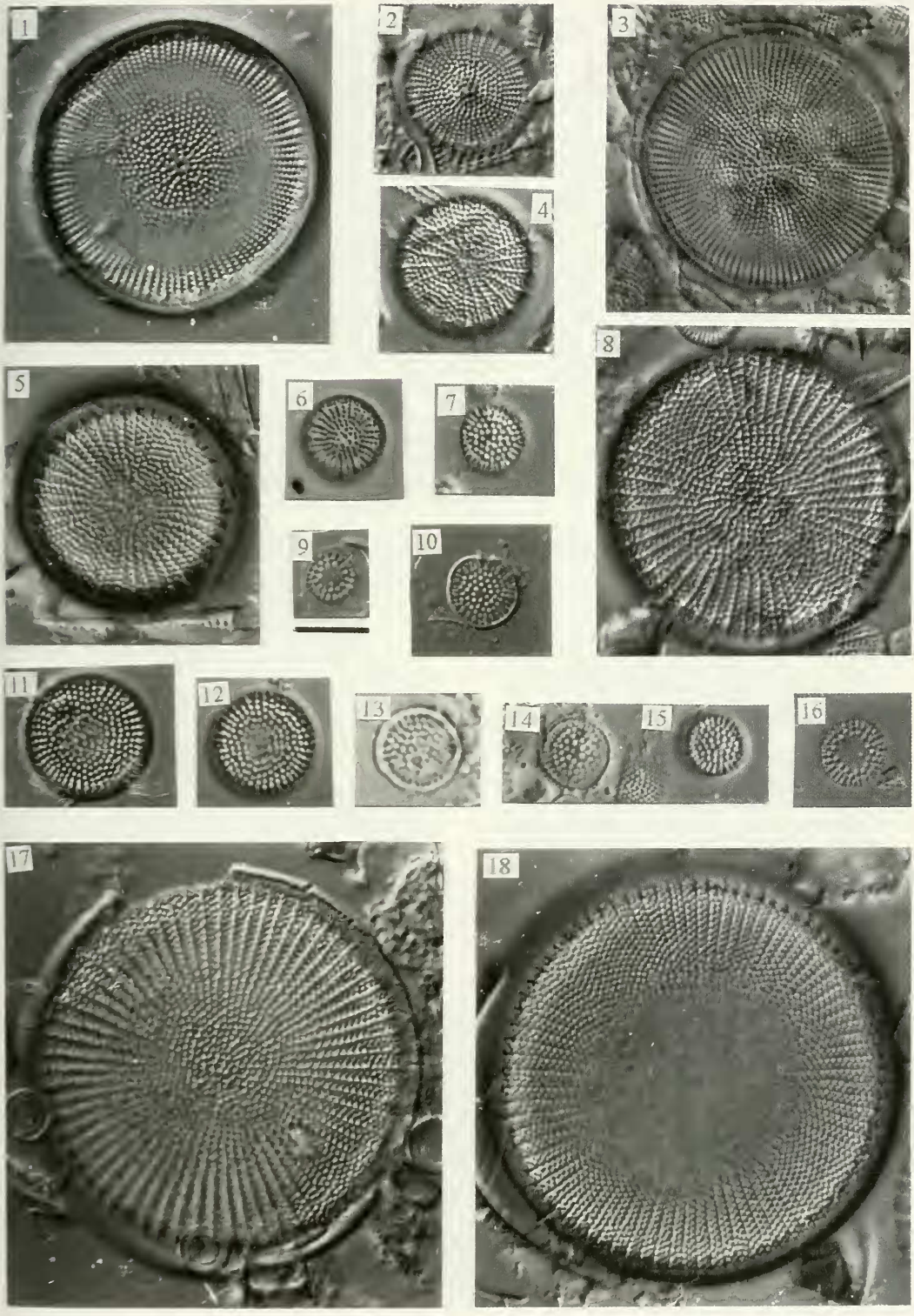
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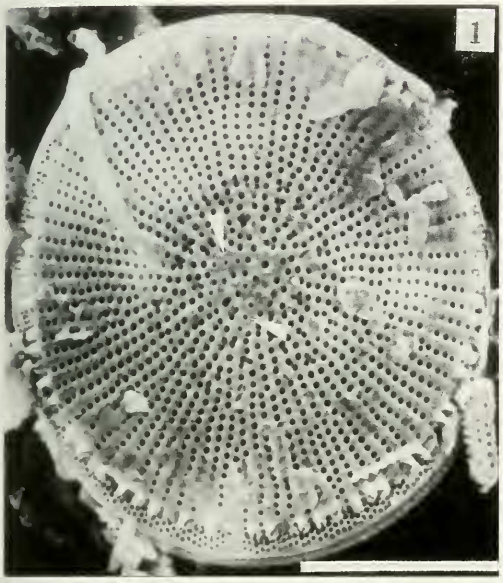
Plate 2

Scanning Electron Microscopy

Mesodictyopsis academicus

Figs. 1, 3–4. External views of the valve surface with small openings of valve face fultoportulae near the valve center (arrows); scale bars = 10 μm.

Figs. 2, 5–6. Internal views of the valve surface with a single rimoportula and valve face fultoportulae with three satellite pores near the valve center (arrows). Scale bars = 10 μm in Figs. 2–6; scale bar = 1 μm in Fig. 5.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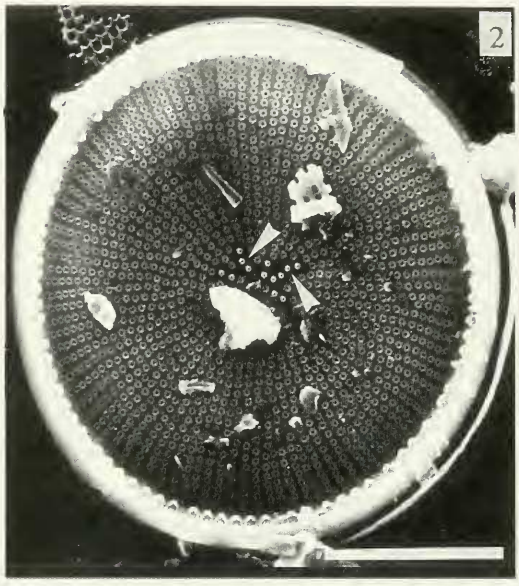
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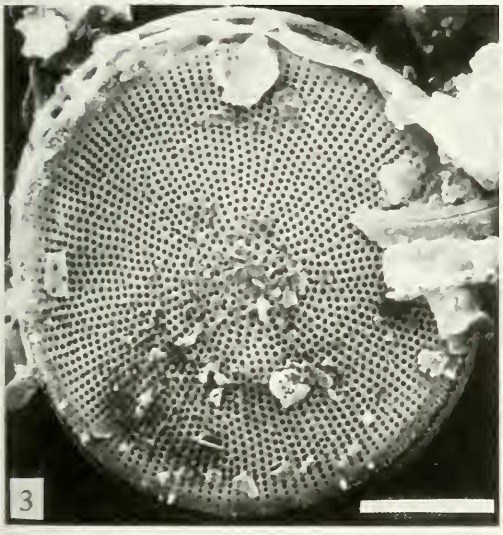
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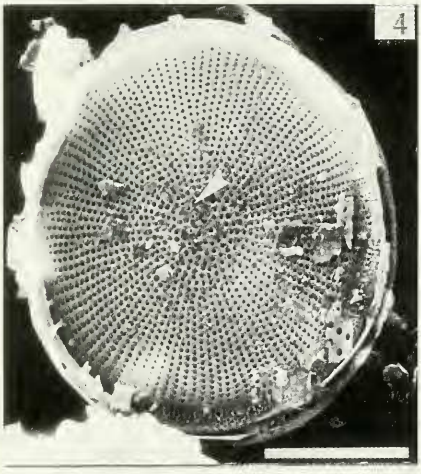
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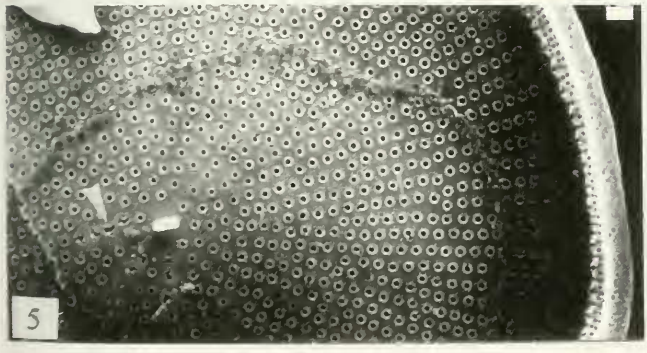
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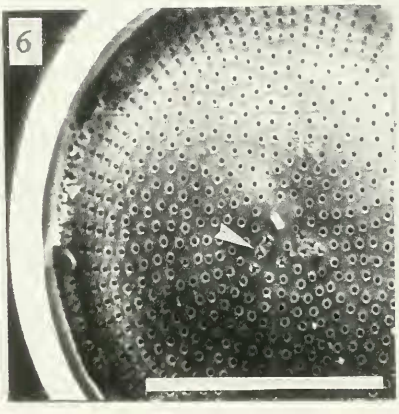
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Plate 3

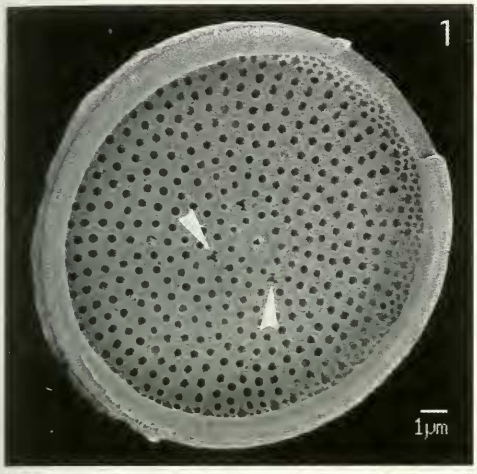
Scanning Electron Microscopy

Mesodictyopsis medius

Figs. 1–2, 4. 6. Internal views of the valve surface with a single rimoportula in the valve center and an irregular ring of valve face fultoportulae with three satellite pores located at the distance ⅓–½ from the valve center (arrows).

Fig. 3. Fragment of internal view of the valve surface with a cribrum inside of loculus (arrow).

Fig. 5. External view of the valve surface with a ring of valve face fultoportulae openings (arrows), scale bars =1 μm.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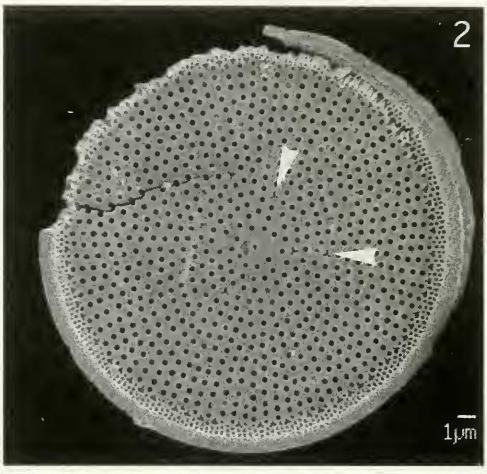
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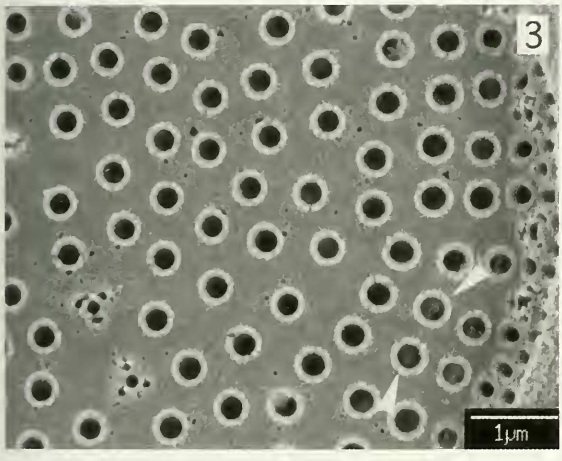
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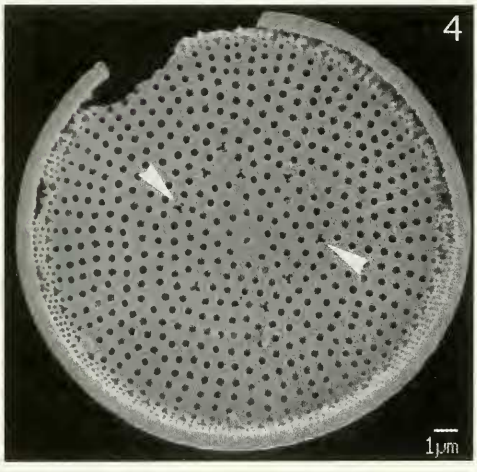
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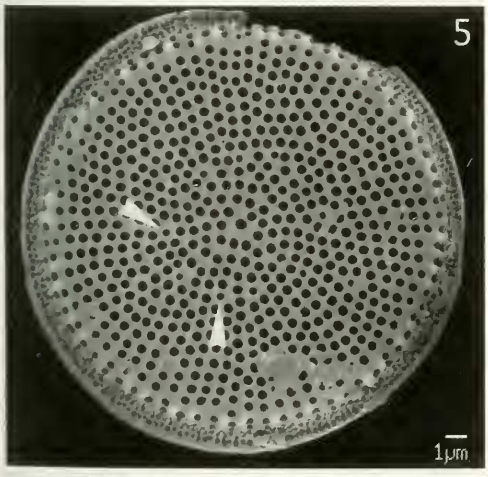
1µm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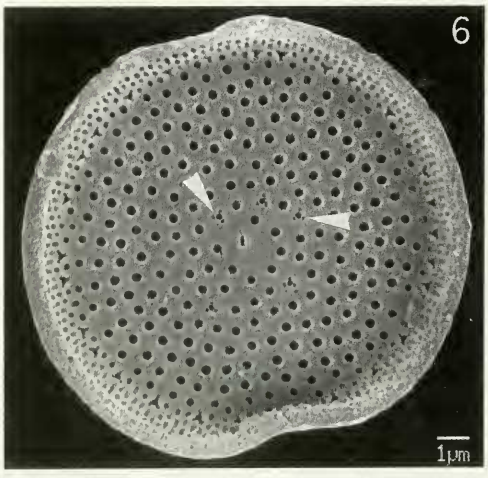
1µm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1µm

Plate 4

Scanning Electron Microscopy

1–2. *Mesodictyopsis peculiaris*

1. External view of the valve surface with a single opening of the valve face fultoportula near the center (arrow); scale bar = 2 μm.

2. Internal view of the valve surface with a single rimoportula in the submarginal zone of the valve face (black arrow) and one valve face fultoportula with two satellite pores near the center (arrow); scale bar = 1 μm.

3–5. *Mesodictyopsis singularis*

3, 5. External view of the valve surface with one opening of the valve face fultoportula near the center (arrow); scale bars = 1 μm.

4. Internal view of the valve surface with a single valve face fultoportula with three satellite pores (arrow) and a ring of marginal fultoportulae with three satellite pores; scale bar = 1 μm.

6–7. *Mesodictyopsis similis*

6. External view of the valve surface with a wide hyaline central area and one opening of the valve face fultoportula near the center (arrow); scale bar = 2 μm.

7. Internal view of the valve surface with a single rimoportula located on the same level with marginal fultoportulae (arrows); scale bar = 2 μm.

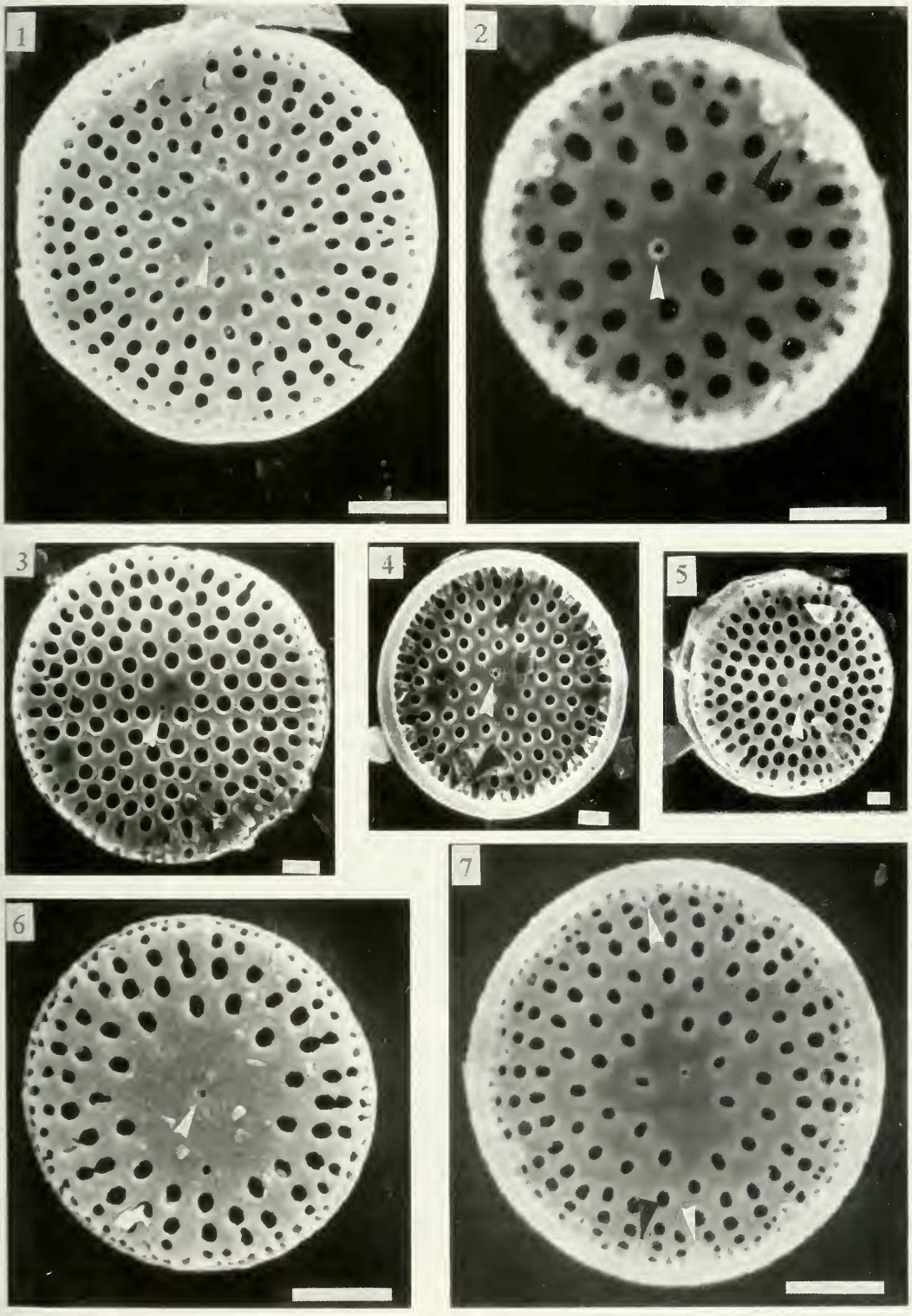
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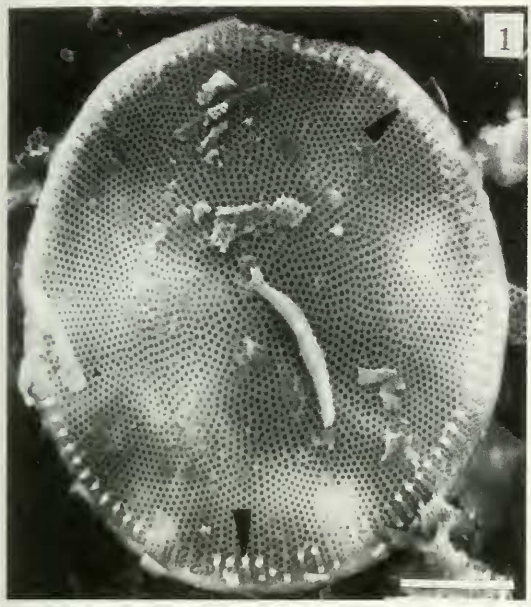
Plate 5

Scanning Electron Microscopy

Mesodictyopsis baicalensis

1, 3–4. External views of the valve surface with a ring of conic spines at the valve face/mantle junction and a single opening of the valve face fultoportula near the center (arrows); scale bars = 10 μm in Fig. 1, 1 μm in Figs. 3–4

2, 5–6. Interval view of the valve surface with a marginal ring of rimoportulae (arrows); scale bar =10 μm Fig. 5, 1 μm in Figs. 2, 6.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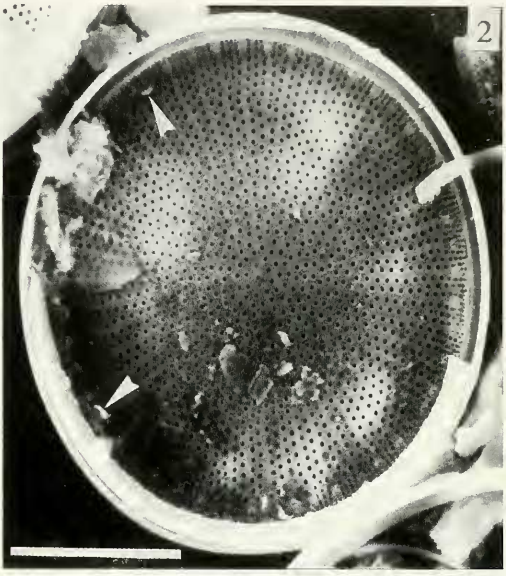
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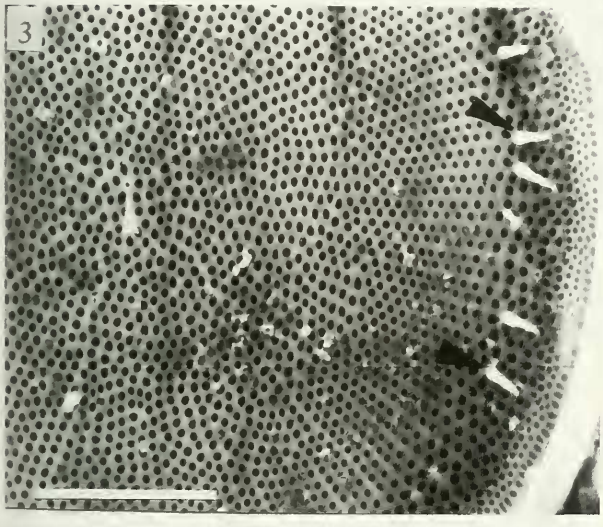
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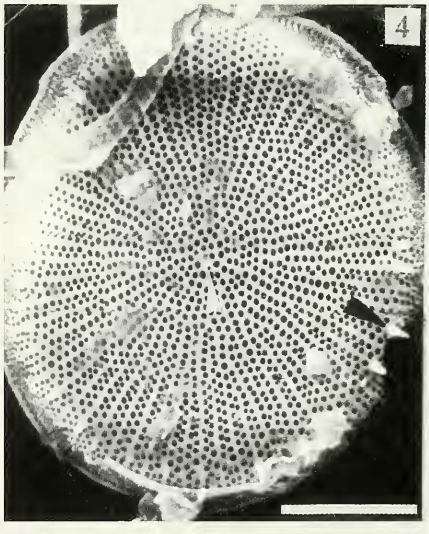
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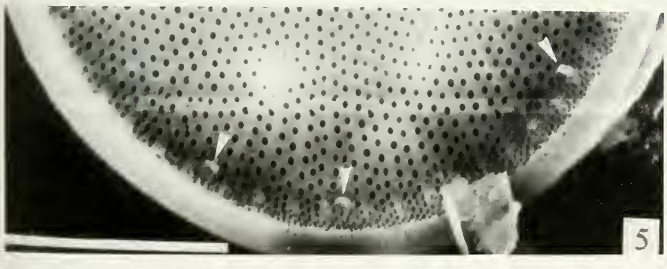
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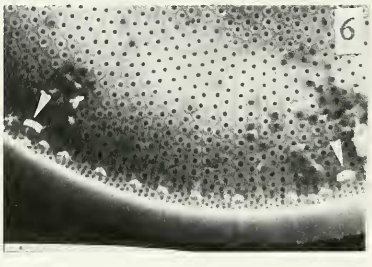
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Plate 6

Scanning Elelctron Microscopy

Mesodictyopsis baicalensis

1, 3. External views showing irregularly-placed, elongate, conical spines at the valve face/mantle junction and short, thin openings of fultoportulae; scale bars = 10μm in Fig. 1, 1 μm in Fig. 3.

2, 4–6. Internal valve views showing pattern of areolae, ring of many marginal fultoportulae and central fultoportulae with three satellite pores (Fig. 6); scale bars = 1μm in Figs. 2, 4, 6 and 10 μm in Fig. 5.